



Spaceport News



John F. Kennedy Space Center - America's gateway to the universe

Missions accomplished!

The space shuttle. There was never another spacecraft like it . . . as large as a DC-9 airliner, but strong enough to withstand the vacuum of space . . . big enough to carry huge satellites and built to be reused dozens of times. And it had wings, just like the imagined spaceships science fiction writers designed for their fantastic tales of adventure. And there may never be another spacecraft quite like it again.

Every employee who has worked at Kennedy Space Center during the past 30 years has followed his or her own unique career path, but one thing they all have in common is the lasting impression the space shuttle fleet has made on their lives.

As NASA's Space Shuttle Program came to a close, a few of them shared their thoughts of gratitude, sadness and pride in the shuttles' legacy:

Bob Youngquist, physicist, NASA: "The space shuttle provided a steady flow of challenging problems that kept many of us motivated and focused on something important and tangible. I will cherish this time and am grateful I had this opportunity."

James Sconiers, area

Space Shuttle Program Final Numbers

Individuals Flown: **355**

Total Fliers: **852**

Miles Traveled: **542,398,878**

Earth Orbits: **21,156**

Time in Space: **1,332 days, 20 hours, 1 minute, 34 seconds**

supervisor, Brevard Achievement: "To be part of the space program has been the most rewarding time of my working life. To all, 'thank you.'"

Mark Nappi, vice president of Launch and Recovery Systems, United Space Alliance (USA): "The Space Shuttle Program has been a mark of American ingenuity and technical superiority. As equally important, it's also been an op-

portunity to showcase an American work force with extreme passion, dedication and innovation. This American

treasure may never be replicated again."

Rachel Wiedemann, aerothermal engineer, The Boeing Co.: "The space shuttle has meant seven years of the most incredible, inspiring job I could have ever asked for. I have had the joy of waking up for work and being excited about what I do. It has allowed me to play a fulfilling role in a part of American culture that has brought

us improvements in communication, technology, medicine and space exploration. Not only that, it also has provided me with the opportunity to meet truly wonderful people and work on a unique and iconic piece of history."

Robert Smith, aircraft servicer, URS Federal Technical Services: "Working at KSC the last 10 years has been a dream come true. Working around true American heroes and being a part of a team as big as ours here has forever changed my life."

Roger McCormick, former aerospace technician, USA: "Growing up in West Virginia I read and studied all I could dealing with every facet of space exploration, knowing that one day I would move to Florida and work at the place where rockets are launched. The Space Shuttle Program allowed me to fulfill my dream for nearly 23 years, working hands on with the orbiters every day."

Stanley Starr, Applied Physics branch chief, NASA: "The Space Shuttle Program has provided me with a career of fascinating technical challenges, allowed

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"This mission (STS-135) marks the final flight of the Space Shuttle Program and also ushers in an exciting new era, to push the frontiers of space exploration and human spaceflight."

President Barack Obama



"The shuttle program brought our nation many firsts and many proud moments. I was proud to be part of the shuttle program and will carry those experiences with me for the rest of my life."

Charlie Bolden
NASA Administrator



"The space shuttle has provided unbelievable benefit and return on the investment of the American taxpayer. This is not the end, but the start of the next chapter."

Lori Garver
NASA Deputy Administrator



"What this team has accomplished during the past 30 years will be talked about and admired for generations to come. We have accomplished what no one else has been able to do."

Bob Cabana
Kennedy Space Center Director

Congress honors NASA on historic milestones

On July 13, 2011, the Senate unanimously passed Resolution 233, honoring America's space agency and its workers. It reads:

Honoring the men and women of the National Aeronautics and Space Administration Space Shuttle Program on reaching the historic milestone of the 135th and final flight of the Space Transportation System.

Whereas the launch of the space shuttle Atlantis on July 8, 2011, is the 135th and final flight of the National Aeronautics and Space Administration Space Transportation System (STS-135) and the 33rd flight of the space shuttle Atlantis;

Whereas the National Aeronautics and Space Administration built 5 space-capable orbiters, the Columbia, the Challenger, the Discovery, the Atlantis, and the Endeavour;

Whereas, with the launch of STS-135, 355 indi-

viduals will have flown 852 times during the history of the Space Shuttle Program, beginning with the launch of the first Space Transportation System flight on April 12, 1981;

Whereas a spirit of international partnership has been fostered among the 16 countries represented on the space shuttle missions flown during the history of the Space Shuttle Program, including Belgium, Canada, France, Germany, Israel, Italy, Japan, Mexico, the Netherlands, Russia, Saudi Arabia, Spain, Sweden, Switzerland, Ukraine, and the United States;

Whereas the space shuttles together have flown 537,114,016 miles, with STS-135 adding an additional 4,000,000 miles;

Whereas, during the history of the Space Shuttle Program, more than 2,000 on-orbit experiments have been conducted in the fields of Earth science, biology, fluids, materials sciences,

and astronomy;

Whereas the Space Shuttle Program has executed the launch and service of the Hubble Space Telescope, enabling groundbreaking and breathtaking views of the universe outside of our solar system;

Whereas the space shuttles have docked to 2 different space stations, with 9 missions to Mir, the space station of the Government of Russia, and 37 missions to the International Space Station;

Whereas the Space Shuttle Program has been essential to the on-orbit assembly of the International Space Station and vital to ensuring the continued viability and support of the International Space Station;

Whereas the space shuttles have landed at the Kennedy Space Center 77 times, at Edwards Air Force Base 54 times, and at the White Sands Test Facility once;

Whereas the launch

configuration of the entire Space Transportation System contains approximately 2,500,000 moving parts and, at lift-off, weighs approximately 4,500,000 pounds; and

Whereas the space shuttles can travel around the Earth at a speed of approximately 17,500 miles per hour: Now, therefore, be it Resolved, That the Senate--

(1) congratulates the National Aeronautics and Space Administration on reaching the historic milestone of the 135th and final flight of the Space Transportation System;

(2) honors the men and women of the Space Shuttle Program, who worked tirelessly to design, build, and operate the Space Transportation System, in order to promote science, exploration, and international cooperation;

(3) remembers the 14 crewmembers lost during the space shuttle Challenger accident, which occurred

on January 28, 1986, and the space shuttle Columbia accident, which occurred on February 1, 2003;

(4) notes the diligence in applying the lessons learned through the Challenger and Columbia tragedies to honor the 14 crewmembers we lost and enhance the safety of the crewmembers that followed;

(5) recognizes that the Space Shuttle Program has inspired generations of children to become engineers, scientists, and explorers, which has led to maintaining the precedent of leadership in human space exploration set by the United States during the Mercury, Gemini, and Apollo missions; and

(6) acknowledges that the Space Shuttle Program has, through its technological advancements and scientific research, driven innovation in the fields of science, technology, engineering, and mathematics to benefit the people of the United States and all of humankind.





Challenger OV-099

Total Crew: 60
Miles Traveled: 23,661,290
Earth Orbits: 995
Time in Space:
62 days, 7 hours,
56 minutes, 22 seconds

First called STA-099, Challenger was built to serve as a test vehicle for NASA's Space Shuttle Program. But despite its earthbound beginnings, STA-099 was destined for space as OV-099, or Orbiter Vehicle-099. Bearing the name "Challenger," the shuttle arrived at Kennedy Space Center in July 1982. It was named after the British Naval

research vessel HMS Challenger that sailed the Atlantic and Pacific oceans during the 1870s.

Like its historic predecessors, Challenger and its crews made significant scientific contributions in the spirit of exploration.

Challenger launched on its maiden voyage, STS-6, on April 4, 1983. That mission saw the first spacewalk of the shuttle program, as well as the deployment of the first satellite in the Tracking and Data Relay System constellation.

The shuttle launched the first American woman into space, Sally Ride, on the STS-7 mission (June 1983), and was the first to carry two U.S. female astronauts during the STS-41G (October 1984) mission.

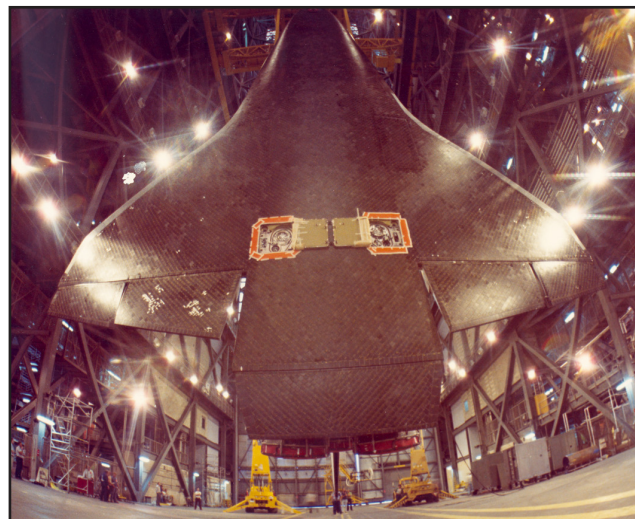
It also launched the first African-American astronaut into space, Guion Bluford Jr., on STS-8 (August/September 1983).

As the first shuttle to launch and land at night on the STS-8 mission, Challenger also made the first landing at Kennedy, concluding the STS-41B mission (February 1984).

Spacelabs 2 and 3 flew aboard the ship on missions STS-51F (July/August 1985) and STS-51B (April/May 1985), as did the first German-dedicated Spacelab on STS-61A (October/November 1985).

A host of scientific experiments and satellite deployments were performed during Challenger's missions.

Challenger also saw the first in-flight capture, repair



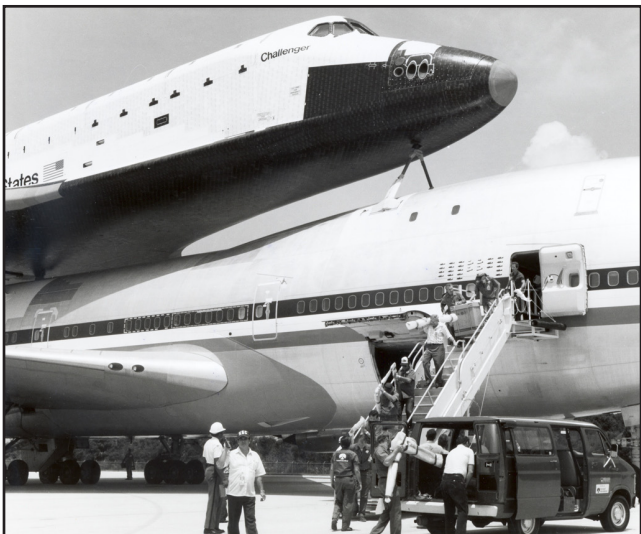
NASA file/1982

Space shuttle Challenger is raised vertically Nov. 23, 1982, on a special lifting sling in preparation for mating with its external fuel tank and solid rocket boosters in High Bay 3.

and redeployment of an orbiting satellite during STS-41C (April 1984).

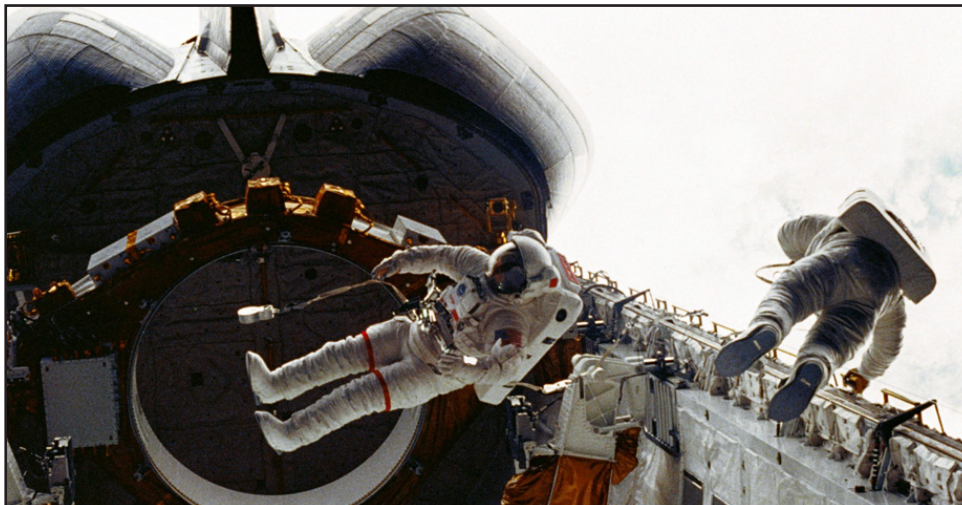
Challenger's service to America's space program ended on Jan. 28, 1986.

Just 73 seconds into the STS-51L mission, Challenger's seven astronauts and spacecraft were lost when a booster failure caused an explosion.



NASA file/1982

Space shuttle Challenger arrives at Kennedy Space Center on July 5, 1982.



NASA file/1983

Astronauts Story Musgrave, left, and Donald Peterson float in the cargo bay of space shuttle Challenger during their April 7, 1983, spacewalk on the STS-6 mission, the first of the shuttle program.

In Memoriam

Spaceport News honors all the astronauts and space workers who sacrificed their lives for America's space program so that we may live a better life.



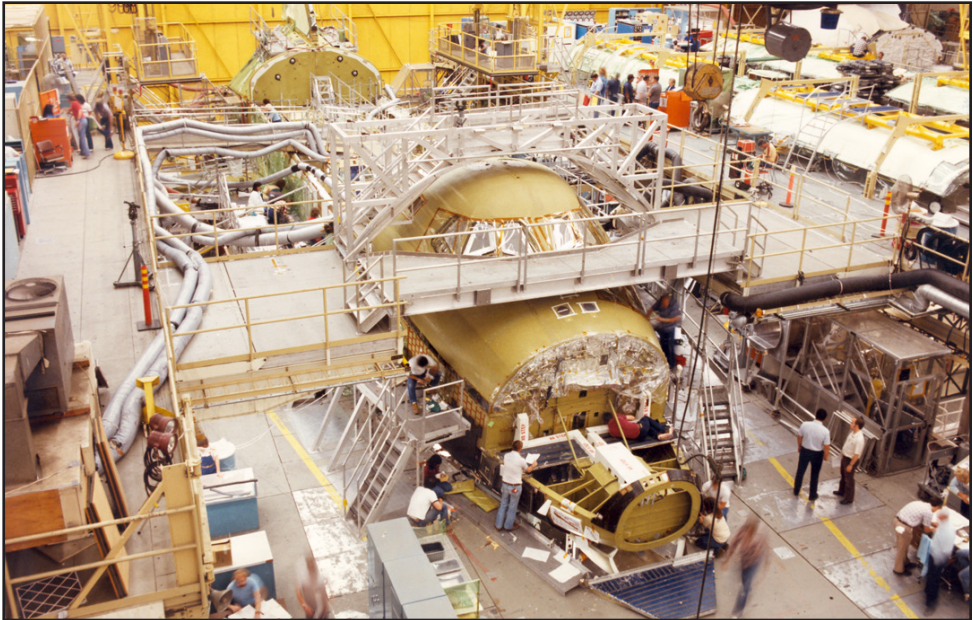


Columbia OV-102

Total Crew: 160
Miles Traveled: 121,696,993
Earth Orbits: 4,808
Time in Space:
300 days, 17 hours,
40 minutes, 22 seconds

A bright white Columbia roared into a deep blue sky as the nation's first reusable space shuttle April 12, 1981. Named after the first American ocean vessel to circle the globe as well as the command module for the Apollo 11 moon landing, Columbia continued NASA's heritage of intrepid exploration. Columbia, commonly referred to as OV-102, for

Orbiter Vehicle-102, carries a legacy of groundbreaking scientific research and notable firsts in spaceflight. Columbia operated the first Spacelab on STS-9 (November/December 1983). The space-based science lab played host to unprecedented research in astronomy, biology and other sciences. Spacelab ultimately finished where its career began; its 16th and final mission was hoisted into space aboard Columbia in 1998. Columbia also changed the look of astronauts who flew into space from NASA's previous human spaceflight programs. Germany's Dr. Ulf Merbold became the first European Space Agency astronaut when he flew aboard STS-9. Chiaki Naito-Mukai, of Japan's space agency, made



NASA file/1984
Space shuttle Columbia undergoes modifications in Rockwell International's assembly facility in Palmdale, Calif., on May 3, 1984.

history as the first Japanese woman to fly in space on STS-65 (July 1994). Also, Eileen Collins became the first female to command a shuttle aboard

Columbia's STS-93 mission. One of Columbia's greatest achievements was the deployment of the gleaming Chandra X-ray Observatory in July 1999. Carried into space inside the shuttle's payload bay on STS-93, Chandra specialized in viewing deep space objects and finding the answers to astronomy's most fundamental questions. Columbia's service to America's space program

ended on Feb. 1, 2003. As the shuttle lifted off from Kennedy Space Center on Jan. 16, a small portion of foam broke away from the orange external tank and struck the shuttle's left wing. The resulting damage created a hole in the wing's leading edge, which caused the loss of Columbia's seven crew members when the spacecraft broke apart during re-entry into Earth's atmosphere.

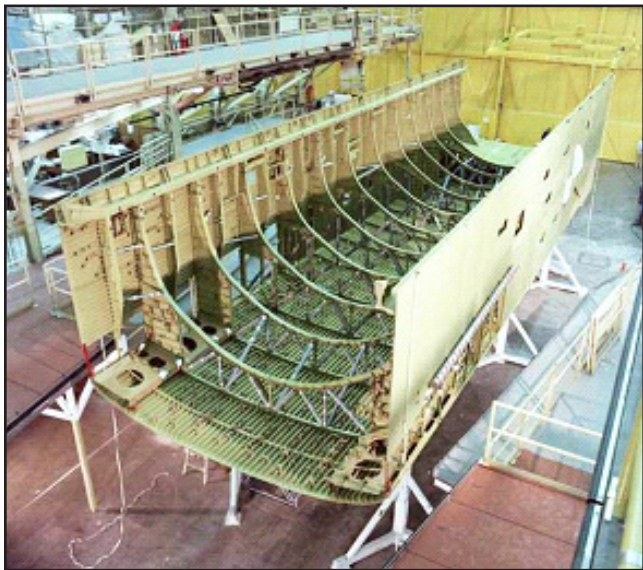


NASA file/1979
Space shuttle Columbia arrives in Orbiter Processing Facility-1 on March 25, 1979. It stayed for 610 days before rolling over to the Vehicle Assembly Building in preparation for STS-1.



NASA file/1982
Columbia, on its STS-3 mission, was the only shuttle to land at the White Sands Space Harbor near Las Cruces, N.M. The mission ended March 22, 1982.





NASA file/1983

Space shuttle Discovery is constructed in Rockwell International's assembly facility in Palmdale, Calif., in 1983.



NASA file/1984

Space shuttle Discovery, lifts off Kennedy Space Center's Launch Pad 39A on Aug. 30, 1984, beginning its first spaceflight mission, STS-41D.

Discovery OV-103

Total Crew: **252**
Miles Traveled: **148,221,675**
Earth Orbits: **5,830**
Time in Space: **365 days**

Discovery, OV-103, was NASA's third space shuttle to join the fleet. The shuttle arrived at Kennedy Space Center in November 1983, and after checkout and processing, it launched Aug. 30, 1984, for its first mission, STS-41D, to deploy three communications satellites.

Discovery carried on a tradition drawn from some historic, earthbound exploring ships of the past. One of these sailing forerunners was the vessel used in the early 1600s by Henry Hudson to explore Hudson Bay and search for a northwest passage from the Atlantic to the Pacific.

Another such ship was used by British explorer

"Discovery's a workhorse, fleet leader in number of flights. It still looks like a new car after almost 30 years of service. It's a great machine, a great vehicle."

Steve Lindsey
STS-133
Commander

James Cook in the 1770s during his voyages in the South Pacific, leading to the discovery of the Hawaiian Islands. In addition, two British Royal Geographical Society ships have carried the name "Discovery" as they sailed on expeditions to the North Pole and the Antarctic.

Destined for exploring the heavens instead of the seas, it was only fitting that NASA's Discovery carried the Hubble Space Telescope into space during the STS-31 mission in April 1990, and provided both the second and third Hubble servicing missions -- STS-82 in

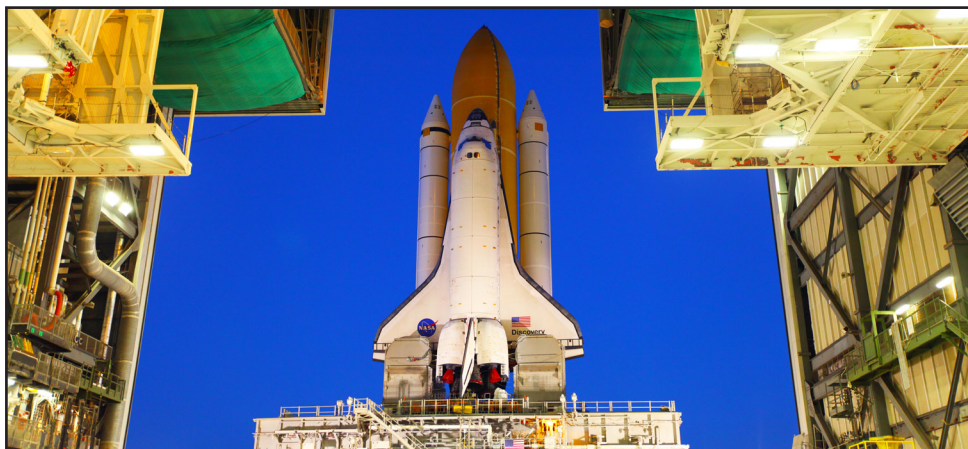
February 1997 and STS-103 in December 1999.

Discovery has the distinction of flying Return to Flight missions twice. The first was for STS-26 (September/October 1988), and the second when it carried the STS-114 crew to the International Space Station in July 2005.

Since its inaugural flight, Discovery completed more than 30 successful missions, surpassing the number of flights made by any other shuttle in NASA's fleet.

During its many successful trips to space, Discovery has carried satellites aloft, ferried modules and crews to the space station, and provided the setting for countless scientific experiments.

Discovery wrapped up its spaceflight journey with the STS-133 mission in March 2011. Now, the shuttle is being prepared for permanent public display at the Smithsonian's National Air and Space Museum Steven F. Udvar-Hazy Center in Virginia.



NASA/Frankie Martin

Space shuttle Discovery begins its nighttime trek, known as "rollout," from the Vehicle Assembly Building to Launch Pad 39A on Sept. 20, 2010, for its STS-133 mission.





NASA file/1981

STS-1 takes off at 7 a.m. ET April 12, 1981, from Launch Pad 39A at Kennedy Space Center. Astronauts John Young and Robert Crippen rode space shuttle Columbia 37 times around the Earth.

From **SHUTTLE**, Page 1

me to work with unbelievably talented people and taught me that even a great organization can fail at times. I’ve been a member of the shuttle family for over 30 years and its ending gives me great sadness.”

Adriana Gomez, Operations Security coordinator, USA: “I have never worked with a more talented and dedicated work force than that at Kennedy Space Center. I am proud to be a part of the remarkable space shuttle legacy.”

Peter Chitko, mechanical systems technical integration manager, NASA: “The space shuttle has afforded me the opportunity to fulfill a childhood dream to be a member of the world’s greatest launch team with the honored privilege of overseeing these priceless national assets.”

Michael Giordano, test engineer, USA: “Working as an engineer on the space shuttle has been an incredible experience and is something that I will cherish and remember for the rest of my life.”

Constantine Daniel, radar technician, CSR: “Our radar is located three and a half miles from pad B, and we tracked every shuttle from launch to landing and even in orbit. Shuttle work is what I did my whole career, from 1978 to 2011. My whole family grew up on shuttles.”

Alyssa Garcia, mission and payload operations engineer, NASA: “I’m always filled with awe every time I lay eyes on our space shuttle. It is a most marvelous vessel in our quest for adventure and knowledge.”

Butch Cabe, Atlantis vehicle project manager, Boeing: “I will always be very proud of being a shuttle team member and of the accomplishments we have made. It has been wonderful to be based here at KSC since STS-1 and to be part of design, assembly, processing, launch and landing recovery of the greatest flying



NASA/Kim Shiflett

About 2,100 Kennedy Space Center employees stand side-by-side to form a full-scale outline of a space shuttle orbiter outside the Vehicle Assembly Building on March 18, 2011. The unique photo opportunity was designed to honor the Space Shuttle Program’s legacy and the people who contributed to safely processing, launching and landing the vehicle.

machine ever.”

Wayne Bingham, Discovery flow manager, USA: “These vehicles really take on their own personality, and we as people have interfaced with them. Now, the end of the era is coming. It’s going to be a tough day not only to see them decommissioned, but it’s really going to be tough to see them ferried off to a future display site.”

Mike Parrish, Endeavour vehicle operations chief, USA: “We love the shuttle program. And we’re all very proud of what we’ve done for the shuttle program.”

Mark Barnes, orbiter operations manager, USA: “I guess it will be kind of a bittersweet memory. You know, these things have been flying for quite awhile and we’ve all been proud to be a part of it and we all will miss that part of it. But, you know, everything has to come to a close sometime.”

Dana Hutcherson, Endeavour flow director, NASA: “I’m happy to share the vehicle with the world. Is it a little bittersweet and sad that we’re going to be ending her career? Yes, it’s a little sad, but you know, it’s a great, spectacular vehicle, and it’s something that we should be sharing with the world and they should be able to see it.”

Jim Bolton, vehicle manager, NASA: “In a few years there’s going to be three space-flown orbiters at three different sites that people are going to be able to get up this close to it. They’re going to be able to get the feel of the size, the feel of what this really is. So I kind of look forward to this knowing that there’s going to be the disappointment as we retire it, but as we prepare the vehicles to go I think it’s going to really make people happy and proud. And I hope that the public, when they have the opportunity to see the vehicles in the museums, see what this has done exactly for the American space program.”



NASA file/1982

Space shuttle Challenger moves through the fog on its way to Launch Pad 39A at Kennedy Space Center on Nov. 30, 1982.



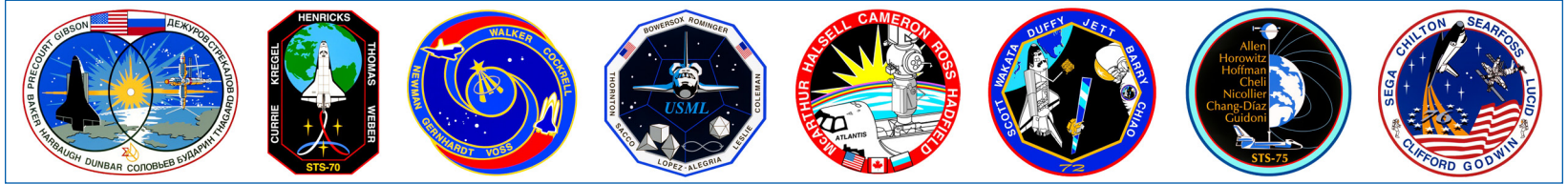
NASA file/1982

NASA’s first shuttle, Enterprise, was constructed without engines or a thermal protection system, making it incapable of spaceflight. However, it did perform test flights in Earth’s atmosphere.



NASA

Space shuttle Atlantis lands on Runway 15 of the Shuttle Landing Facility on July 21, 2011, completing its STS-135 mission. Its main gear touched down at 5:57:00 a.m. EDT, followed by nose gear touchdown at 5:57:20 a.m., and wheelstop at 5:57:54 a.m. The landing is the last of NASA’s Space Shuttle Program.



Endeavour
OV-105
Total Crew: 173
Miles Traveled: 122,883,151
Earth Orbits: 4,671
Time in Space: 299 days

Authorized by Congress in August 1987 as a replacement for space shuttle Challenger, Endeavour (OV-105) arrived at Kennedy Space Center on May 7, 1991, piggy-backed on top of NASA's new Shuttle Carrier Aircraft. For the first time, a shuttle was named through a national competition involving students in elementary and secondary schools. They were asked to select a name based on an exploratory or research sea vessel. In May 1989, President George H. W. Bush announced the winning name. Endeavour was named after a ship chartered to traverse the South Pacific in 1768 and captained by

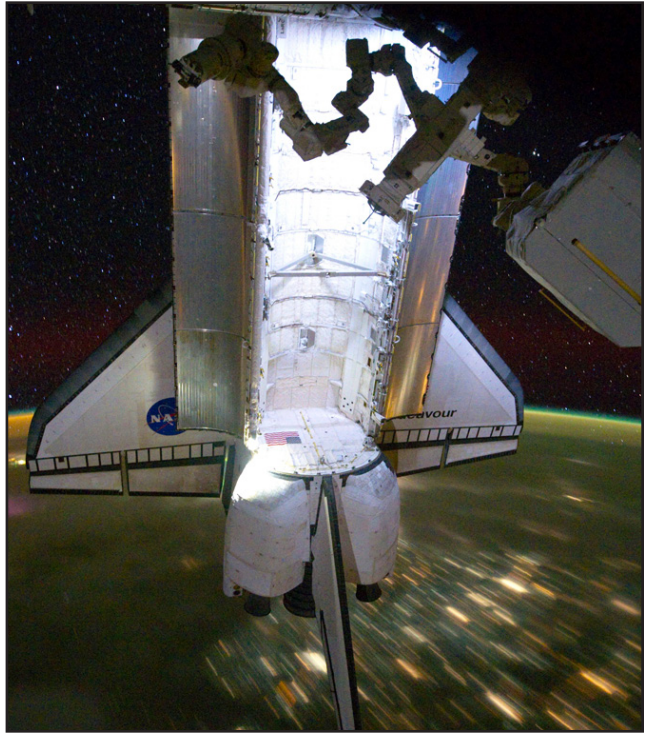
"When I think space shuttles, I think Endeavour in particular, because she was named by schoolchildren all over the country, that really shows a carrying on and a moving forward, and how open-ended and never-ending that future can be."

Barbara Morgan
STS-118
Mission Specialist

18th century British explorer James Cook, an experienced seaman, navigator and amateur astronomer. Endeavour's first mission, STS-49, began with a flawless liftoff on May 7, 1992, beginning a journey filled with excitement, anticipation and many firsts. One of Endeavour's primary assignments was to capture Intelsat VI, an orbiting, but not functioning, communications satellite, and replace its rocket motor. It took three attempts and a deluge of pub-

lic suggestions on ways for the crew to grab the satellite and repairs to be made. The STS-49 crew also recorded footage for an educational video comparing Cook's first voyage with the shuttle's maiden voyage. Throughout Endeavour's illustrious career, the shuttle made history with even more firsts. It conducted the first repair mission to NASA's Hubble Space Telescope on STS-61 (December 1993) and delivered the first U.S. component to the International Space Station on STS-88 (December 1998). Endeavour flew 25 missions. Endeavour finished its spaceflight journey with the STS-134 mission in May/June 2011.

After Endeavour is transitioned and retired, it will head back to where it took root on the west coast of the United States. From the California Science Center in Los Angeles, Endeavour will continue to inspire the next generation of explorers for years to come.



NASA
Backdropped by a night view of Earth and the starry sky, space shuttle Endeavour is photographed docked at the International Space Station on May 28, 2011.



NASA file/1991

Endeavour first arrived at Kennedy Space Center May 7, 1991, atop NASA's new Shuttle Carrier Aircraft. Endeavour made the first service mission to the Hubble Space Telescope on STS-61 (December 1993).



NASA file/1992

Space shuttle Endeavour, lifts off Kennedy Space Center's Launch Pad 39B on May 7, 1992, beginning its first spaceflight mission, STS-49.





NASA file/1985

Space shuttle Atlantis lifts off Kennedy Space Center's Launch Pad 39A on Oct. 3, 1985, beginning its first spaceflight mission, STS-51J.



NASA file/2009

The Hubble Space Telescope stands tall in the cargo bay of space shuttle Atlantis following its capture May 13, 2009, during the STS-125 mission.

Atlantis OV-104

Total Crew: **207**
Miles Traveled: **125,935,769**
Earth Orbits: **4,848**
Time in Space: **307 days**

NASA's fourth space-rated space shuttle, OV-104 "Atlantis," was named after the two-masted boat that served as the primary research vessel for the Woods Hole Oceanographic Institute in Massachusetts from 1930 to 1966.

Construction of Atlantis began March 3, 1980. Weighing in at 151,315 pounds when it rolled out of Rockwell International's assembly plant in Palmdale, Calif., Atlantis was nearly 3.5 tons lighter than shuttle Columbia.

Like its seafaring predecessor, Atlantis has carried on the spirit of exploration with several important missions. On Oct. 3, 1985, Atlantis launched for the first time on the STS-51J mission with a classified payload for the U.S. Department of Defense. The spacecraft went on to carry four more DoD payloads into space.



NASA file/1985

Space Shuttle Atlantis arrives April 9, 1985, between rain showers and clouds from Rockwell International's assembly facility in Palmdale, Calif.

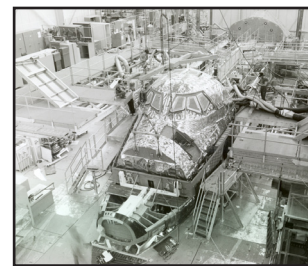
"Atlantis has done a lion's share of work with regard to the (International Space Station) assembly, it did the last Hubble servicing mission, so Atlantis will have a proud legacy as far as I'm concerned."

Doug Hurley
STS-135
Pilot

Atlantis also served as the in-orbit launch site for many noteworthy spacecraft, including planetary probes Magellan and Galileo, as well as the Compton Gamma Ray Observatory. An impressive array of onboard science experiments took place during most missions to further enhance space research in low Earth orbit.

Starting with STS-71 (June/July 1995), Atlantis pioneered the Shuttle-Mir endeavor, flying the first seven missions to dock with the Russian space station. During STS-79 (September 1996), the fourth docking mission, Atlantis ferried astronaut Shannon Lucid back to Earth after her record-setting 188 days in orbit aboard Mir.

In recent years, Atlantis has delivered several vital

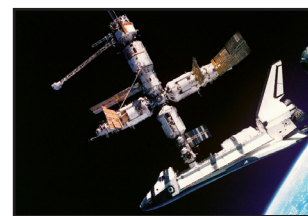


NASA file/1984

Space shuttle Atlantis is built inside Rockwell International's assembly facility in Palmdale, Calif., on April 13, 1984. Atlantis, designated OV-104, arrived at Kennedy Space Center on April 9, 1985.

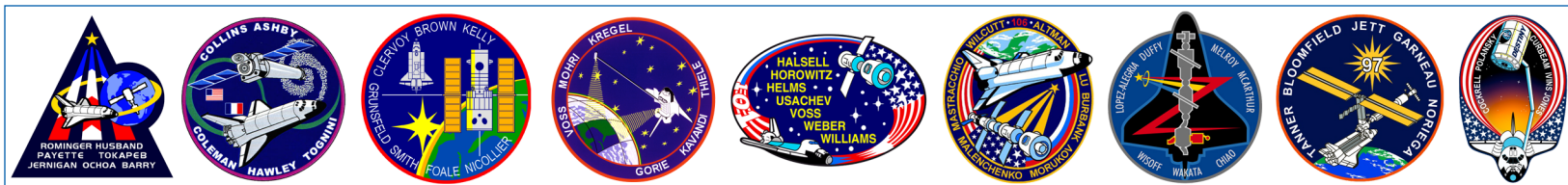
components to the International Space Station, including the U.S. laboratory module, Destiny, as well as the Joint Airlock Quest and multiple sections of the integrated truss structure that make up the station's backbone.

Atlantis completed its final spaceflight mission, STS-135, at 5:57 a.m. EDT July 21, 2011, and will continue to call Florida's Space Coast home. The shuttle will join the rockets, capsules and artifacts from the Mercury, Gemini and Apollo eras at the Kennedy Space Center Visitor Complex. From there, NASA will have the unique opportunity to share its unparalleled tale of flying the world's first reusable spacecraft.



NASA file/1995

Space shuttle Atlantis connects to Russia's Mir space station July 4, 1995.





SRBs, SSMEs and ETs played integral role

STS-1 SRB segments used on STS-135 mission

When Atlantis' STS-135 mission lifted off from Launch Pad 39A on July 8, 2011, on NASA's final space shuttle launch, it was carried aloft by the last two solid rocket boosters (SRBs) assembled at Kennedy Space Center for the Space Shuttle Program. Two of the SRB's major components also helped launch Columbia on the first space shuttle launch.

External Fuel Tank/SRB Vehicle Manager Alicia Mendoza said the cylinder on the left-hand forward motor segment and the forward skirt on the right-hand forward assembly flew on STS-1 in 1981. "Components flown on the first and last missions of the program are a fitting testament to the robustness of the reusable design of the SRBs," Mendoza said. "Even of



NASA/Ben Cooper

A crawler-transporter moves a mobile launcher platform with two solid rocket boosters perched on top from the Vehicle Assembly Building's High Bay 1 to High Bay 3 at Kennedy Space Center on Oct. 27, 2010.

greater significance is the professionalism of the unique team of thousands of individuals who have retrieved, refurbished and assembled the hardware during the past 30 years." For three decades, the twin SRBs provided the

forward assembly, just below the nose cone, to distinguish it from the right SRB during re-entry into the atmosphere and retrieval operations out in the Atlantic Ocean.

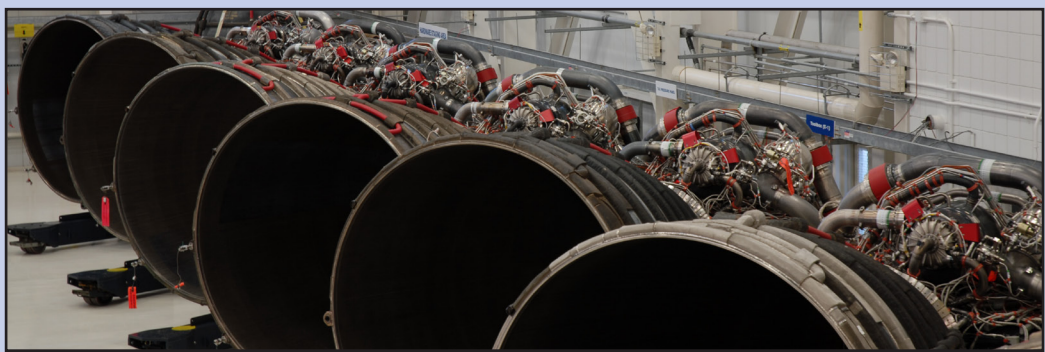
Several facilities at Kennedy were used to process the SRBs major components.

The boosters arrived in eight segments by railcar from ATK in Utah.

"It takes 22 days to build the four segments into a flight-ready SRB stacked on the platform," Mendoza said.

At Kennedy, about 600 NASA, USA and ATK engineers and technicians worked to process the SRBs from beginning to retrieval until after launch.

"Their skill, dedication and passion are the reasons for the success of this great nation's Space Shuttle Program," Mendoza said.



For NASA/Steven Siceloff

Space shuttle main engines stand lined up in the Space Shuttle Main Engine Processing Facility at Kennedy Space Center on Nov. 24, 2010.

Main engines proven to be extreme machines

The space shuttle main engines have been one of the brightest success stories of the space shuttle's career. Powered by a combination of fuel and oxygen, a single SSME, as the engines are called, produces about 500,000 pounds of thrust. Working with the two solid rocket boosters for the first two minutes of launch, three main engines push a shuttle up to Mach 25 and into orbit in eight and a half minutes.

"We call the SSME an extreme machine and it's extreme because on the inlet you've got liquid oxygen and liquid hydrogen and liquid hydrogen is minus 420 degrees Fahrenheit," said Daniel Hausman, the Kennedy Space Center Site Manager for Pratt and Whitney Rocketdyne, the company that built and maintained the engines. "So it's extremely old propellant that we're putting through the turbo machinery and then we're burning it in the main combustion chamber at 6,000 degrees Fahrenheit."

It can do that without melting because the engine pumps the cryogenic hydrogen through a series of 1,040 tubes lining the nozzle.

"There's no other piece of machinery that can operate between a minus 423 degrees F

and a plus 6,000 degrees F," said Stephen M. Herridge, a main engine systems engineer for United Space Alliance.

Each engine relies on a set of turbopumps to push fuel and oxygen so it can burn efficiently. The turbopumps produce more power than a locomotive, even though they would fit on a desk.

"If you look at the engine and you think about putting 1,000 pounds a second through the diameter of a dinner plate, that's what that engine does," Hausman said.

The engines' success did not come easy. Engineers began testing engine designs in 1975, at NASA's Stennis Space Center in Mississippi.

Through all the challenges, the engines, the only ones of their kind to be reusable, have been enormously successful throughout the program.

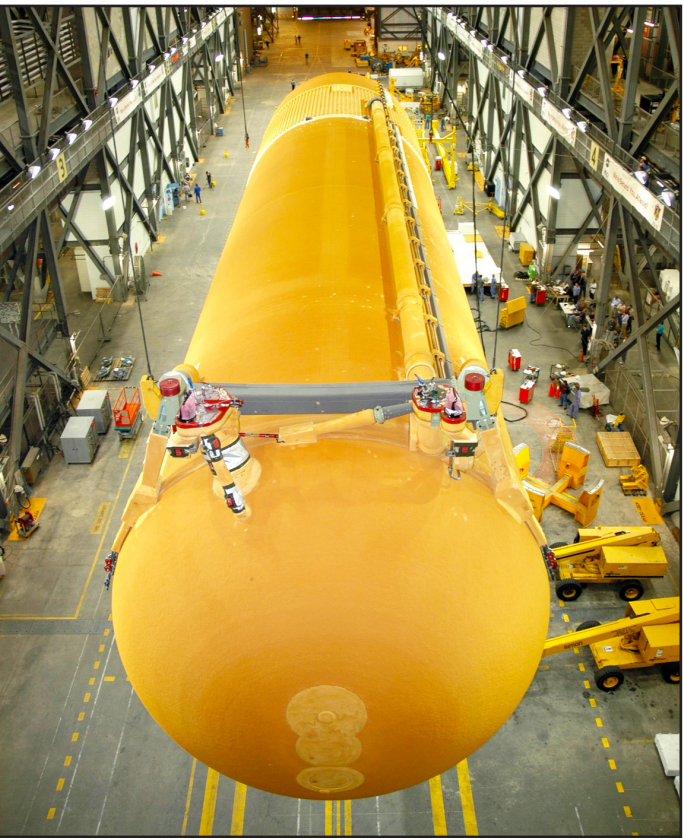
"I'll rank the space shuttle main engines at the top, I think as far as the extreme temperatures, the pressure they operate, the weight, the fact that they have been reusable, that they have been so reliable since STS-1 to STS-135," Herridge said. "I still rate the main engines at the top."

External tank provided backbone

It is a riveting sight -- the external fuel tank attached to a space shuttle, with twin solid rocket boosters (SRBs) on either side, as they emerge from the Vehicle Assembly Building (VAB) perched atop the mobile launcher and carried by the crawler-transporter to the launch pad. Moving slowly along the crawlerway, the tank's distinctive orange color shines like a beacon as if to indicate that something exciting is about to happen.

External Tank-138, or ET-138, helped launch NASA's last space shuttle flight, Atlantis' STS-135 mission, on July 8, 2011, from Launch Pad 39A at Kennedy Space Center. Though not the last tank to be delivered to Kennedy, it was the last flight tank.

Arriving at Kennedy on July 13, 2010, it had,



NASA/Jim Grossmann

An external fuel tank is lifted off its transporter in Kennedy Space Center's Vehicle Assembly Building on March 2, 2006.

like every tank before it, made the 900-mile journey to Florida's Space Coast from NASA's Michoud Assembly Facility in Louisiana.

Unfueled, each tank weighed in at 58,000 pounds and 1.6 million pounds

when fueled. Standing more than 15 stories tall, it was the largest single part of a shuttle stack, sometimes referred to as the "backbone" of the space shuttle.

"The external tank actually provides the struc-

tural background of the space shuttle system by absorbing the thrust loads produced at launch by the orbiter and the boosters," said Alicia Mendoza, the ET/SRB vehicle manager.

The tank's familiar orange

color came from the foam insulation sprayed on its aluminum structure. The insulation helps the tank act as a thermos bottle to keep 535,000 gallons of super-cold liquid hydrogen and liquid oxygen from evaporating too quickly. It also helped prevent ice from forming on the tank's exterior and promoted the right aerodynamic shape for launching into space.

The tanks were painted white for the first two shuttle flights. But in order to reduce launch weight by 600 pounds, subsequent tanks were left in their natural orange state beginning with the STS-3 mission.

After a few revisions to designs and materials, the latest version of the tank, known as the super lightweight tank, was 17,000 pounds lighter than the first one Columbia used in 1981.





NASA/Frankie Martin

Thousands of workers who have processed, launched and landed NASA's space shuttles for more than three decades welcome space shuttle Atlantis home during an employee appreciation event July 21, 2011.

Word on the Street: What will you remember most about NASA's Space Shuttle Program?



"Just seeing the excitement of the people who come from everywhere to see a launch."
Robert Washington,
United States Air Force



"The pride of being involved with the Space Shuttle Program. The shuttle is a national treasure."
Titus Mayes,
Abacus Technology



"I was here for the first one, got to meet Bob Crippen and John Young on STS-1. It was like being on another planet, something I'll never forget."
Matt Sisko,
United Space Alliance



"The shuttle program is just a phenomenal experience. We are the true leaders. Not everyone can say that."
Jerick McLeod,
Naval Ordnance Test Unit



"It's been an exciting time. We're talking about a project unique to the entire world."
Ray Kindred,
The Boeing Co.



"What it has meant to the next generation. . . our future in science and technology."
Chuck Loftin,
Kennedy Space Center

"The fact that I'm a space shuttle baby. I was born in 1981."

Alicia Muzzy,
Team QNA



"Feeling you belong to something . . . that is what being a part of the Space Shuttle Program was all about."

Russell Fiske,
United Space Alliance



"I've just loved hearing the sonic booms since I was young from wherever I was living in Florida. Those last ones were the most significant to me."

Amy O'Brien,
NASA Exchange



"It inspired me to get a higher degree for the next phase of American human space travel."

Matthew Baker,
Abacus Technology



"Participating in science payloads and all the projects I worked on made me proud to be an American."

Barbara Navarro,
Ames Research Center



"Our shuttle family. It's a great bunch of people . . . all dedicated to launching the shuttles and bringing them back to Earth safely."

Diane Stees,
Kennedy Space Center



"The first night launch I saw . . . it was so bright you could read a newspaper."

Roxanne Pistel,
REDE-Critique



"To see it from start to finish . . . it's been 31 years to this month. I feel a lot of American pride."

Heather Mitchell,
Johnson Space Center



"What this program has brought to all Americans . . . all the experiments and inventions made my life easier and more convenient."

"It's something that no one has ever accomplished except the USA. There's nothing else like it."

John Kelley,
All Points Logistics



"I wouldn't be here without the shuttles. They inspired me to become an engineer. I still remember building LEGO shuttles."
Matt Schottel,
Johnson Space Center



"It's always been a constant. It always gives you warm feeling when you see a shuttle."

"Return to Flight after Columbia we overcame tragedy to get back in space again. It showed we were the leaders in space."
Lara Kearney,
Johnson Space Center



Patrick Renna,
Millennium Engineering and Integration



John F. Kennedy Space Center

Spaceport News

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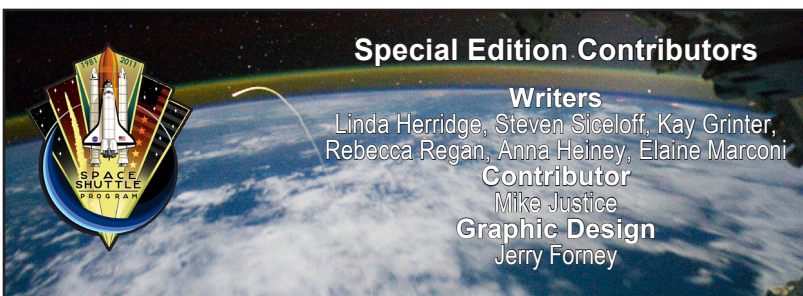
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This unprecedented view of space shuttle Atlantis' re-entry during the final shuttle mission, STS-135, was photographed on July 21, 2011, by the Expedition 28 crew of the International Space Station.